IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: **Kim et al.** **GROUP:** Unknown

SERIAL NO: Unknown **EXAMINER:** Unknown

FILED: **Herewith**

FOR: **METHOD OF PRODUCING DEVICE QUALITY (A1) InGaP ALLOYS ON LATTICE-MISMATCHED SUBSTRATES**

Box Non-Fee Amendment
Assistant Commissioner of Patents
Washington, D.C. 20231
Sir:

PRELIMINARY AMENDMENT

Preliminary to examination, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Delete the sentence on page 1, lines 5 and 6, and insert therefore -- This application is a continuation of Ser. No. 09/499,217 filed November 24, 1999, which claims priority from provisional application Serial No. 60/109,619 filed on November 24, 1998.--

Please insert the following sponsorship information at page 1, line 9:

-- This invention was made with government support under Grant No. DAAG55-97-1-0111 awarded by the United States Army. The government has certain rights in the invention--.

REMARKS

The present amendment is submitted in order to provide the appropriate priority information and appropriate sponsorship information.

Respectfully submitted,

Matthew E. Connors
Registration No. 33,298
Samuels, Gauthier & Stevens
225 Franklin Street, Suite 3300
Boston, Massachusetts 02110
Telephone: (617) 426-9180
Extension 112

METHOD OF PRODUCING DEVICE QUALITY (Al)InGaP ALLOYS ON LATTICE-MISMATCHED SUBSTRATES

PRIORITY INFORMATION

This application is a continuation of Ser. No. 09/499,217 filed November 24, 1999, which claims priority from provisional application Serial No. 60/109,619 filed on November 24, 1998.

BACKGROUND OF THE INVENTION

This invention was made with government support under Grant No. DAAG55-97-1-0111 awarded by the United States Army. The government has certain rights in the invention.
The invention relates to the field of producing device quality (Al)InGaP alloys on lattice-mismatched substrates.

Epitaxial graded composition buffers of $In_xGa_{1-x}P$ on GaP substrates ($In_xGa_{1-x}P$/GaP) are promising substrates for high performance optoelectronic devices. $In_xGa_{1-x}P$ alloys with large bandgaps that are difficult or impossible to achieve lattice-matched to GaAs substrates can be grown on graded buffers, providing direct bandgap emission of the critical green to orange wavelengths that lie between the capabilities of GaN-based and GaAs-based light emitting diode (LED) and laser diode technologies. $In_xGa_{1-x}P$/GaP substrates are also inherently transparent to devices grown on them, which roughly doubles light extraction efficiency in LEDs compared to absorbing substrates such as GaAs. The transparency of $In_xGa_{1-x}P$/GaP has also been used to produce negative electron affinity GaAs and InGaAs photocathodes that operate in transmission mode, and a variety of other optoelectronic detectors and modulators can be envisioned to take advantage of a transparent semiconductor substrate. Furthermore, GaP is nearly lattice-matched to Si, so $In_xGa_{1-x}P$/GaP is one natural choice for integrating compound semiconductor devices on Si substrates.

Graded buffers are grown to efficiently relieve lattice-mismatch strain between substrates and films of differing lattice constants. For most optoelectronic device applications, direct bandgap compositions of $In_xGa_{1-x}P$ are desired. The >2% lattice-mismatch between GaP and direct bandgap compositions of $In_xGa_{1-x}P$ results in heavily defective single heterostructures, due to the large and abrupt introduction of strain at one interface. A graded buffer of $In_xGa_{1-x}P$ on GaP slowly introduces strain over many interfaces, which minimizes dislocation interactions, maintains a low state of strain, and minimizes dislocation nucleation during growth. Consequently, graded buffers typically have orders of magnitude lower threading dislocation densities than single heterostructures.